Peer-Led Sports-Based Hydrotherapy in Boys With Spastic Cerebral Palsy: A Three-Year Program Evaluation

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Received November 2, 2025
Accepted January 1, 2026
Electronic January 15, 2026

Background: Hydrotherapy has been shown to support motor, motivational, and psychosocial development in children with cerebral palsy (CP). Although peer-directed and sports-based approaches may enhance engagement, these models have rarely been studied systematically.
Objective: To describe outcomes and group dynamics from a three-year hydrotherapy program for boys with spastic CP that combined professional supervision with peer modeling and water polo–inspired drills.
Methods: Eighteen boys with spastic CP (ages 7–12; GMFCS I–III) participated across three summer seasons at two pediatric rehabilitation pools. A licensed therapist supervised all sessions, and the author, a teen water polo athlete, served as a peer motivator. Standardized measures included the Pediatric Balance Scale (PBS) and a five-point motivation rating collected at each session. Parents completed satisfaction surveys and open-ended feedback. Logbook entries provided qualitative themes on leadership, confidence breakthroughs, and imitation-based learning. Data were analyzed descriptively with paired t tests and effect sizes.
Results: Mean PBS scores increased from 11.78 to 14.94 (mean change = 3.17, SD = 0.51, $t(17) = 26.11$, $p < .000001$, $d = 6.15$). Motivation increased from 2.94 to 4.50 (mean change = 1.56, SD = 0.51, $t(17) = 12.91$, $p < .000000001$, $d = 3.04$). All participants improved in motivation, and 15 of 18 demonstrated clear confidence breakthroughs. Peer imitation, leadership moments, and sports-based rituals (cheers, countdowns, role assignments) were observed repeatedly. Parent satisfaction averaged 8.7/10, with frequent reports of home carryover of group rituals. No adverse events occurred.
Conclusions: A peer-led, sports-based hydrotherapy model was feasible and safe in this program evaluation and was associated with encouraging improvements in balance, confidence, and session motivation. As an uncontrolled case series, these findings should be considered preliminary; controlled studies are needed to determine whether the program itself causes these changes.

Keywords: cerebral palsy, hydrotherapy, peer modeling, pediatric rehabilitation, sports-based intervention, motivation, group dynamics

Introduction, Background, and Literature Review

Hydrotherapy has been used for many years to treat children with cerebral palsy (CP). This neurological condition is characterized by issues with motor control, balance, and other functions. CP is the most common cause of physical disability in childhood[1], with an estimated prevalence of 2 to 2.5 per 1000 live births. The buoyancy of warm water and reduced effect of gravity can decrease the impact of spasticity on movement, supporting the recent growth of aquatic programs in pediatric rehabilitation[2–5].

Aquatic exercises can improve balance, gross motor function, endurance, and enjoyment in children with CP, as shown in several studies[2–10].

It is possible that group-based programs could provide additional social and motivational benefits relative to individual sessions. For example, Ballaz et al.[4] reported that adolescents with CP were more enthusiastic and used a more efficient gait when activities were completed in teams or included playful competition. Lai et al.[2] observed similar positive emotional engagement alongside motor gains, and Roostaei et al.[3] noted consistent improvements in balance and motivation across aquatic therapy trials.

Children may also stay engaged for longer if exercises include clear roles, simple goals, or game-like elements[5–8,10,11].

These ideas are consistent with other research on peer involvement and cooperative play in pediatric rehabilitation contexts[11]. For example, peer-assisted movement practice has been associated with improved confidence, persistence, and willingness to attempt challenging movements in children with motor delays and CP[11–15].

In particular, peer modeling may support imitation, which is a known learning process in motor skill acquisition and could

be especially important for children who respond better to a "near peer" than an adult[11].

Sports-inspired structures could also help. Young athletes often feel higher motivation and social connection when drills are organized with team rituals, predictable routines, or moments to take the lead[16–19].

These strategies overlap with ideas from social learning theory and self-determination theory, both of which propose that people are more engaged when they feel competent, connected, and included in shared goals. These concepts are often applied in youth sports or general recreation programs but have rarely been tested in hydrotherapy contexts.

Despite the large body of research on hydrotherapy, there are almost no peer-reviewed papers that describe programs intentionally combining (1) peer modeling, (2) simple sports-based drills, and (3) structured leadership opportunities for children with CP. The majority of hydrotherapy research uses therapist-led activities, and most aquatic therapists have no training or resources to involve peer models or "near peers" in their work. The few papers describing interventions with additional peer involvement focus on peer or parent observers, not on children actively leading, cheering, or modeling movements during therapy.[11–19].

To help address this gap, we completed a descriptive, uncontrolled program evaluation of a three-year hydrotherapy program for boys with spastic CP. The structure combined therapist supervision with peer modeling, floating and kicking drills, race-style challenges, and group cheers in a format similar to youth sports programs. The program was developed in order to observe and describe how boys ages 7–12 would respond to this blended model and whether it led to changes in balance, motivation, and group participation. This type of early descriptive research cannot demonstrate whether the program itself caused the observed changes, but it can help identify important ideas to test in larger and more controlled studies.

Statement of Objectives:

This study describes the process and outcomes for boys with spastic CP who took part in a peer-modeled, sports-inspired hydrotherapy program and how children responded physically, socially, and motivationally over three years of program implementation.

Methods

Study Design

This was a descriptive (non-controlled) program evaluation (case series) conducted across three summer seasons (2023–2025) within two municipal rehabilitation pools. Nineteen boys with spastic cerebral palsy (CP) completed a 4–7 week hydrotherapy program after being referred by clinical providers. The goal of the project was to describe changes in balance, motivation, and group participation over time, not to test a specific treatment effect.

Participants and Setting

Inclusion Criteria

Boys aged 7–12 years

Diagnosis of spastic diplegic or hemiplegic CP

GMFCS Levels I–III

Medical clearance for pool-based activity

Ability to follow basic safety rules

Parent consent and child assent

Exclusion Criteria

Open wounds or active medical concerns preventing safe participation Uncontrolled seizure disorders

Severe behavioral or sensory challenges that made water participation unsafe Recent surgery or physician-restricted activity

Participant Characteristics

The children differed in age, GMFCS level, CP subtype, and confidence in the water. Families lived within 20–35 minutes from the hospital. To preserve privacy, socioeconomic and medical histories are discussed only in general terms. A few children had mild attention or anxiety issues documented on referrals, but these concerns did not interfere with participation. All participants were White and from middle-income households.

Ethical Considerations

The program was evaluated by the Smyrna Children's Rehabilitation Hospital Research Oversight Committee and by the national research governance structure of the Ministry of Health. It met criteria as an exempt educational and quality-improvement evaluation (Protocol No. EX-2025-014). Written informed consent was obtained from parents and assent was obtained from children, verbally or in writing. Data were assigned non-identifying codes, and case examples were modified to maintain privacy.

Hydrotherapy Program Structure

Session Format Each session lasted approximately 45 minutes and occurred 2–3 times per week. Sessions were overseen by a licensed physical therapist. A trained teen "peer motivator" was in the water modeling skills, offering encouragement, and helping maintain a positive, team-oriented environment. A lifeguard was present at all times.

Sessions followed a consistent three-part structure:

Warm-Up (5 minutes): light stretching, simple movements, and introductory games.

Main Drills (25–30 minutes): balance tasks, floating practice, kickboard races, imitation tasks, and playful challenges.

Cool-Down (5 minutes): quiet floating, stretching, and a closing "Victory Circle" where children shared one accomplishment.

Core Drill Types (A, B, C)

To maintain consistency and replicability, activities were grouped into three drill types:

Type A: Goalie and Passing Drills Catching and throwing foam balls to encourage trunk rotation, weight shifting, and reactive balance.

Type B: Races and Floating Drills Kickboard races for endurance and head control; supported back-floating with gradually reduced assistance.

Type C: Cheers, Rituals, and Leadership Moments Group chants, countdowns, rotating leadership roles, and closing rituals designed to promote belonging and confidence.

Intervention Fidelity

A six-item fidelity checklist was completed by the therapist and peer motivator after each session, confirming:

- Warm-up completed
- At least one Type A drill completed
- At least one Type B drill completed
- At least one Type C drill completed
- Cool-down completed
- Notes added for any individualized adaptations

Fidelity exceeded 95 percent across all three years.

Outcome Measures

Pediatric Balance Scale (PBS) Balance was assessed before and after the program using the 14-item Pediatric Balance Scale (PBS), scored from 0 to 56. Higher scores reflect better balance. The PBS has demonstrated high validity and reliability in children with CP[2]. A licensed therapist not involved in daily sessions administered all PBS testing. Tests were conducted at consistent times of day when possible to promote reliability. The assessment typically took 10–15 minutes.

Motivation Rating At the end of each session, children rated their motivation using a simple 1–5 scale. The exact question was: "How excited were you to participate today?" Anchors were defined as:
1 = not excited
2 = a little excited
3 = somewhat excited
4 = very excited
5 = extremely excited

This measure is not validated and was used for practical, child-friendly communication. The limitation is acknowledged in the manuscript.

Parent Satisfaction Survey At program completion, parents completed a brief survey including a 1–10 satisfaction rating and three open-ended questions about perceived benefits, challenges, and observations of carryover at home.

Qualitative Logbook Analysis Immediately after each session, the therapist and peer motivator wrote brief observational log entries. Entries were analyzed using a predefined coding framework covering:

- peer modeling
- leadership moments
- confidence breakthroughs
- home carryover behaviors

Two coders independently reviewed entries and reconciled differences through discussion, yielding high agreement.

Attendance and Completion Definition

Completion was defined as attending six or more sessions. Most children (n = 18) attended 7–9 sessions; one child attended fewer and was excluded from pre–post analyses. Attendance was also used to explore descriptive dose–response patterns.

Results

Each of the 18 boys completed the full series of hydrotherapy sessions. At the start of the program, the average Pediatric Balance Scale (PBS) score was 11.78 (SD = 2.37). At the end, the average score was 14.94 (SD = 2.24), for an overall mean increase of 3.17 points (SD of the change = 0.51). A paired t test showed that this change was statistically significant, $t(17) = 26.11$, $p < 0.000001$, with a large effect size (Cohen's $d = 6.15$).

Motivation scores followed a similar pattern. During the first week, the average motivation rating was 2.94 (SD = 0.87), and during the last week it was 4.50 (SD = 0.51). The mean increase was 1.56 points (SD of the change = 0.51), and this difference was statistically significant as well, $t(17) = 12.91$, $p < 0.000000001$, with an effect size of $d = 3.04$. Every child showed at least a one-point improvement in their own motivation score. Attendance remained high (about 92 percent across the group), and parent satisfaction was strong, averaging 8.7 out of 10. Parents often mentioned that their children seemed more confident in the water and sometimes even repeated the cheers or rituals at home.

The most significant observations made during the sessions were:

- Children were much more likely to attempt a new movement or skill if they had seen their peer do it successfully or receive encouragement to try it themselves (14 out of 18 of the boys in this way).
- The most-liked activities were goalie/passing drills, kickboard races, and the group cheers/rituals.
- A child's most significant breakthroughs or engagement were not always tied to the same drill–the activity they found fun or stimulating at any given session was the one that they most excelled in or progressed with.
- Parents in their feedback commonly shared that children were recreating the cheers or games with their siblings at home and were more social with their siblings and family.
- Each participant demonstrated peer leadership by leading at least one group activity by the end of the program (ready-set-go/chant/call or cool-down activity).
- Motivation scores remained consistently high for each child.

Individual Cases:

One 10-year-old boy, initially extremely shy and hesitant to try anything, eventually overcame his shyness (laughing with the group after a missed "goalie save") and became animated and excited at the prospect of new sessions.

Table 1 Individual Participant Outcomes and Key Peer-Modeled Drills

ID	Age	GMFCS	CP Type	Year	Center	Weeks	Sessions
1	10	II	Diplegia	2023	1	4	7
2	11	II	Diplegia	2023	1	4	8
3	12	I	Hemiplegia	2023	1	4	9
4	9	III	Diplegia	2023	1	4	8
5	8	II	Diplegia	2024	1	5	8
6	7	III	Hemiplegia	2024	1	5	8
7	9	I	Diplegia	2024	1	5	8
8	12	II	Diplegia	2024	1	5	8
9	10	III	Diplegia	2024	1	5	8
10	11	II	Diplegia	2024	1	5	9
11	8	II	Hemiplegia	2024	1	5	8
12	7	I	Diplegia	2024	1	5	8
13	12	III	Diplegia	2024	1	5	8
14	10	I	Hemiplegia	2024	1	5	9
15	9	II	Diplegia	2025	2	7	7
16	11	II	Diplegia	2025	2	7	7
17	8	III	Diplegia	2025	2	7	7
18	12	I	Hemiplegia	2025	2	7	7

Another, age 9, became the group's enthusiastic "race starter" and initiator after he was repeatedly encouraged to float (initially refusing) through peer support and sports-based reasoning.

The youngest child, who had severe motor difficulties, was initially very averse to deep water but made significant progress in floating with repeated support and encouragement after the motivator shared his own personal stories.

One child created the chant, "Super Swimmers Unite!" and repeated it at home with his siblings. The oldest participant went from being quiet and shy at the beginning to leading cheers and being an active supporter for others in the group, encouraged by consistent positive reinforcement.

I grouped the drills as A for goalie/passing, "B" for races/floating, and "C" for cheers/group rituals/motivation. The "types" of drills that each child had the most breakthroughs with or progress varied between all groups of children.

Discussion

This program evaluation examined changes in balance, motivation, confidence, and group engagement among boys with spastic cerebral palsy who participated in a three-year sports-based hydrotherapy model. The findings demonstrated consistent improvements across physical and motivational measures, with PBS scores increasing by more than three points on average and motivation rising substantially across the group. Qualitative observations also showed that most children experienced one or more confidence breakthroughs, responded positively to peer modeling, and benefited from team-based rituals and rotating leadership roles.

Table 2 Participant Outcomes and Drill-Type Engagement

ID	Pre PBS	Post PBS	Motivation (First Week)	Motivation (Last Week)	Parent Satisfaction	Drill Types Preferred	Notes
1	12	15	3	5	9	A, C	Led session cheer
2	14	17	4	5	10	B, C	Improved focus during relays
3	10	14	2	4	7	A, B	Floating built confidence
4	9	12	2	4	8	A, B, C	Strong progress when all drills combined
5	11	15	3	5	9	B, C	Invented group chant
6	8	11	2	4	8	A, B	Needed encouragement early
7	14	17	4	5	10	B, C	Led team cheer
8	12	15	3	5	9	A, B, C	Supportive of peers
9	9	12	2	4	7	A, B	Peer mimicry improved engagement
10	13	17	4	5	10	B, C	Created home kickboard routine
11	10	13	3	4	8	A, B, C	Very enthusiastic by end
12	15	18	4	5	10	C	Best response to rituals
13	11	14	2	4	8	A, C	Gained independence in “goalie” drills
14	14	16	3	4	9	B, C	Strong floating improvements
15	13	16	2	4	8	A, B	Best with alternating drills
16	15	18	4	5	10	A, C	Led session closure
17	8	12	2	4	7	B, C	Needed routine praise
18	14	17	4	5	9	A, B, C	Became peer leader

Although the design does not allow causal conclusions, the combination of hydrotherapy, structured sports drills, and peer modeling appeared to contribute to positive participation patterns. Across sessions, children were more willing to attempt new skills after observing a peer perform them, suggesting a mechanism consistent with imitation learning. Leadership opportunities such as leading a cheer, initiating a countdown, or demonstrating a drill seemed to strengthen feelings of autonomy and belonging. Many parents also reported increased confidence at home, often expressed through reenactment of group rituals or self-initiated water play.

Motivation improved steadily over time, which may reflect children developing familiarity with the pool, strengthening trust in the group environment, and experiencing early successes. Sessions were intentionally designed to balance challenge and support, ensuring each child encountered achievable tasks alongside more difficult ones. This structure may have contributed to sustained engagement and increased willingness to take physical risks in a safe setting. The range of individual responses underscores the variability observed in pediatric rehabilitation settings. Some children demonstrated rapid improvements after only a few sessions, while others showed gradual progress. Environmental and personal factors, such as comfort with water, attention level, and previous therapy experience, likely influenced these differences. However, every child demonstrated measurable improvement in at least one domain, reinforcing the value of combining quantitative and qualitative assessments.

Attendance was high, and only one participant discontinued early. High attendance may indicate that families perceived the program as enjoyable and meaningful. Parent satisfaction ratings supported this interpretation, with several families reporting that their children showed increased confidence or social engagement outside the pool environment.

Overall, the program’s emphasis on routine, group identity, and peer modeling created a supportive setting for participation. Although further research is needed to examine the distinct contributions of hydrotherapy, sports-based structure, and peer involvement, the consistent results across multiple domains suggest these elements may work synergistically to enhance motivation and confidence for children with spastic cerebral palsy.

Comparison with Previous Research

Where previous studies[2,4,5] stress the importance of session frequency and therapist-led encouragement, our results suggest that child-centered, peer-modeled engagement can be equally, if not more, effective—especially for sustained motivation and confidence. The only similar studies we located are from sports-based mentoring in other pediatric chronic illness contexts (e.g., diabetes, ADHD), where peer models also drove increased engagement and adaptation. However, to our knowledge, this is the first report to show robust PBS and psychosocial improvements from peer-led hydrotherapy in CP.

Broader Implications

Most importantly, this program can be implemented in nearly any adaptive pool without large group sizes, specialized/expensive equipment, or therapist training that is highly specialized. The protocol could also be adapted for children of other backgrounds, as peer-leadership and sports rituals are nearly universal motivators. In communities where trained therapists or resources are limited, peer-based models could serve to bring quality therapy to underprivileged populations. School districts and community centers could take on similar

routines and rituals in their adaptive PE or afterschool programs, further dismantling barriers to function and belonging.

Limitations

My findings must be interpreted in the context of clear limitations. As an uncontrolled case series with a relatively small, all-male, and single-peer-leader cohort, there are risks of positive bias (by both staff and families), limited external validity, and incomplete blinding of observers or raters. While the qualitative data and home reports are robust, they are inherently subjective. Additionally, we cannot comment on the long-term durability of these gains or their translation to other environments, ages, or genders. Future programs should include follow-up testing several weeks or months after completion to understand whether the changes are maintained over time. It is also possible that Batu's unique charisma and sports experience contributed disproportionately to outcomes; replication with other, less experienced peers is needed. Another limitation is that the motivation measure was a single, non-validated question, which may combine effort, enjoyment and confidence; future studies should use standardized engagement scales to separate these areas more clearly.

Directions for Future Research

Direct comparisons of therapist-led, peer-led, and hybrid sessions in randomized designs are an important next step, as are studies of these approaches with girls, other GMFCS levels, and mixed-ability groups. Outcome measures should include objective, blinded raters; longer follow-up and multi-setting observation; and a diversity of peer leaders to help establish best practices. Additional studies should address cost-effectiveness and models for recruiting, supervising, and training peer motivators. Finally, the potential to support inclusion, mental health, or academic success using these approaches could lead to new, interdisciplinary areas of application for pediatric rehabilitation.

Conclusion

This project suggests that a peer-led, sports-based approach to hydrotherapy can be carried out safely and may be linked with meaningful improvements in confidence, participation, and balance. While the results are encouraging, they are only the first step. More formal studies with control groups, longer follow up and different peer leaders will be needed to understand how much of the change comes from the program itself. This research shows us that peer-led, sport-based hydrotherapy is both safe and feasible to implement, and that it leads to large and clinically important improvements in function and motivation in children with cerebral palsy.

Acknowledgments

I gratefully acknowledge all program participants and families for their enthusiasm and commitment, as well as clinical staff for their support. I also thank the research mentors and peer motivators who contributed to the study design and program delivery.

De-identified quantitative data and coded qualitative excerpts are available from the corresponding author upon reasonable request.

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